Months.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	Totals.	Annual mean.
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
February	0	0	0	0	1	1	0	1	1	0	0	0	0	0	4	0.29
March	1	1	0	1	0	0	1	2	1	0	1	0	0	0	8	0.57
April	2	1	0	2	1	3	3	2	4	0	2	2	3	3	28	2.00
May	3	3	0	5	5	5	2	4	2	3	3	5	2	8	50	3.57
June	7	3	4	3	4	8	6	6	3	10	5	7	10	2	78	5.57
July	9	8	5	8	10	4	3	2	4	11	8	10	7	9	98	7.00
August	4	5	9	2	12	3	3	6	6	8	5	5	7	9	84	6.00
September	2	6	0	4	2	2	1	5	2	2	2	3	4	4	39	2.79
October	0	0	1	0	1	2	2	1	0	1	0	0	0	0	8	0.57
November	0	0	0	2	0	0	0	0	0	0	0	0	1	0	3	0.22
December	1	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0.14
Annual	29	27	19	27	36	28	21	30	23	35	27	32	34	35	402	28.7

This table apparently gives us a close approximation to the normal distribution of thunderstorm days in that locality. It will be noticed that we have here not the number of storms, but the number of days on which one or more storms occurred. The record does not include thunderstorms at an indefinitely great distance, but only those that were near enough to give audible thunder, and this rarely occurs when the storm is more than 10 miles distant; in fact a distance of 3 miles would appear to be a fair average for the storms here recorded.

The months in which thunderstorm days were most numerous were: August, 1887, 12; July, 1892, 11; July, 1887, June, 1892, July, 1894, June, 1895, 10. The average number for July was 7, and the average number for the whole year, 29. The maximum was 36 in 1887.

AUDIBILITY OF THUNDER.

The audibility of thunder depends not merely on the initial intensity of the crash, but equally on the surroundings of the observer, since in the quiet country one will observe feeble sounds that escape the ear in a noisy city. But perhaps the most curious and important condition of audibility is that the thunder, or wave of sound, shall not be refracted or reflected by the layers of warm and cold air between the observer and the lightning or by the layers of wind, swift above and slow below, so as to entirely pass over or around the observer. Sound is somewhat analogous to a wave phenomenon, and consequently is subject to refraction when it passes obliquely through layers of air of different densities. Such refraction may occur at any time and place. Thus observers at the topmast of a ship frequently hear fog whistles that are inaudible at sea level; those on hilltops hear thunder that is inaudible in the valley; those in front of an obstacle hear sounds inaudible to those behind it. The rolling of thunder, like that of a distant cannonade, may be largely due to special reflections and refractions of sound. Again, the greater velocity of the air at considerable altitudes above the ground distorts the sound wave and shortens the limit of audibility to the leeward, but increases it to the windward. In this way it happens that the thunder from very distant storms rarely reaches the ear. Lightning may be seen and its illumination of clouds and mist may be recognized when it is even 200 miles distant, but thunder is rarely audible 10 miles. Hence we see the need of a large number of stations if we would catch the record of every thunderstorm that happens. Probably one for every 25 square miles would not be too many. On the other hand, a few stations would suffice, at least for the nighttime, if each should report the direction and movement of every case of distant lightning.

MOVEMENTS OF WINDS AND CLOUDS IN MINNESOTA.

Mr. O. F. Rice, of Pine Island, Minn., inquires "why storm clouds appear so often on our west and winds come so constantly from the southern directions?"

As this very general question was penned in July, the Editor thinks it likely that Mr. Rice had in mind the southerly winds of the summer season in Minnesota, for the question can hardly refer to the average winds of the whole year, since in the winter time these come from the north or northwest. If one studies carefully the charts of resultant winds published regularly on Chart No. IV of the MONTHLY WEATHER REVIEW, he will perceive that in passing from the summer to the winter and *vice versa*, a gradual change takes place, not only in the direction of the winds, but also in the distribution of the temperature and barometric pressure of the lower atmosphere. These observations although made at the surface of the earth give us reason to believe that the average temperature of the mass of air above Minnesota, Manitoba, and the neighboring region is in summer much warmer than over the country to the westward of the Rocky Mountains. It will also be noticed that the barometric pressure in this central portion of the continent is, in the summer time, lower than on the Pacific Coast to the westward, and especially lower than on the Atlantic Coast to the south and east. The winds move in obedience to the differences of pressure prevailing in the neighborhood of the station. These differences may be due either to differences of temperature—by reason of which cold, dense air underflows and raises up warmer, light air—or they may be due to the differences of pressure at any level by reason of which regions of great pressure push their air into the regions of low pressure. Both of these causes are usually active in the free atmosphere, and doubtless the southerly winds of Minnesota represent the resultant effect of the general distribution of pressure and temperature in North America—not only at the surface of the ground but in the free air above the ground.

If we ascend through the lower atmosphere and study the motions of the upper air as shown by the clouds, we find a general rapid movement from west to east or southwest to northeast, showing that the motions of the upper air are largely controlled by the pressures and temperatures prevailing at the upper level. In general, a certain definite mass of air tends to flow down a gentle slope toward the region where the density of the air is less than its own at the same height above sea level. As soon as the motion begins the influence of the rapid diurnal whirl of the earth on its axis is felt by the moving air so that the upper layers above Minnesota move nearly from west to east while the lowest layer at the surface moves from the south or southwest to northeast. Therefore, while the upper clouds and the storms that they attend come from the west the lowest winds are blowing from the south.

In the winter time the distribution of temperature and pressure over North America is such as to force the cold air of Canada southward over Minnesota. The upper layers move more nearly from the west, while the lowest layers come more nearly from the north, so that at the surface of the earth northerly winds are more frequent; consequently, in the winter we do not have southerly winds below and westerly winds above, except on those dates when low pressure prevails in Canada analogous to the low pressures of the summer season.

HOURLY RESULTS FROM SELF-REGISTERS.

The Weather Bureau maintains self-registers for pressure, temperature, wind direction, rainfall, and sunshine at a very large proportion of its stations, and for the wind velocity at all of them, and the general results are given monthly in the elaborate climatological tables contributed by Mr. A. J. Henry, Chief of the Records Division. In continuation of this work Mr. Henry has prepared, for the forthcoming Annual Report